BITS, PILANI K K BIRLA GOA-CAMPUS
SEMESTER-I, 2022-2023
MID-SEMESTER EXAMINATION
COURSE: EEE_INSTR_F473 WIND ELECTRICAL SYSTEMS & ME F483 WIND ENERGY

REG, WT 30%, CB — DATE: 01-NOV-2022
MM 60 — TIME: 90 MIN.
VENUE: D-104 — 4 P.M. TO 5.30 P.M.

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INSTRUCTIONS:

1. The Question Paper contains TWENTY short answer questions, each carrying 3 Marks.
2. You MUST attempt all the questions in the order these appear in the Question Paper.
3. Write precise and complete answer(s) to a question. You must identify your answer with correct Main Question number and sub-question number. Do not write statement of a Question or sub-question. If you choose not to answer a question (main or sub-question), write "Not Attempted" or "NA" against the corresponding question number (Main or Sub-question) and move on.
4. Full marks will be awarded ONLY to a complete and conclusive answer. If a sub-question requires you to write more than one answers, write all answers for completeness of the answer. No partial marks will be awarded to partially correct answer, as the answer will be treated incomplete answer. Invalid answers may be awarded equivalent negative marks.
5. Non-compliance with any of the above Instructions, or instructions issued by the AUGSD, in any form, will lead to rejection of the Answer Book.

Q. 1 Write precise and complete answers to following questions, in the order of appearance:

[3 M X 20 = 60 M]

i. Write the name of grid-connected wind farm studied by you. Which site-specific characteristics of wind energy resource at the wind farm site, can be immediately obtained for characterizing a nearby site?

ii. What are the ranges of wind power potential (W/m^2) at a 50 m above ground level in India defined by NIWE for classification of potential sites for wind power generation? State the name of your home state and the class to which it belongs.

iii. Which season in a year is considered to be appropriate for installation of wind machine in a wind farm? Which season in a year is considered to be useful for wind power generation?

iv. Which theory is used by the manufacturer of a turbine blade for designing the most optimal rotor blade profile for a given micro-site on a wind farm site. Which parameters define the most optimal rotor blade profile?

v. Out of the different aerodynamic control techniques, which control technique is normally used for maximizing extraction of energy from interacting wind? Which technique is cheaper than the other two techniques?

vi. How is a given wind energy conversion system (WECS) classified on the basis of integrated control strategies employed in the WECS? Mention techniques and equipment used for implementing each of the control strategies.

vii. Which technical standards are stipulated for development wind power project? Mention the steps of wind power project development?

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viii. Which standard is stipulated for wind resource assessment at a prospective site? What characteristic information is obtained for wind power project development at the site?

ix. Draw a neatly labeled plot to explain variation of mechanical power produced with tip speed ratio of the rotor blade. Also, show the influence of pitching angle on the plot and influence of the load curve on operating point of the wind turbine.

x. Explain, why is Active Stall Control (ASC) mechanism superior than a pitch control mechanism for 'braking' of wind turbine rotor when the wind speed is in the range 17 m/s to 25 m/s?

xi. Explain durability curve for a given wind farm site. What information from the curve can be obtained for characterizing the site and selection of wind energy conversion system appropriate to the site?

xii. Explain, with appropriate sketches, constructional details of Savonius rotor, Darrieus rotor, and Propeller type rotor. Also, show corresponding maximum values of coefficient of performance (C_p) for each of the rotors.

xiii. What is the generally preferred level of grid voltage at a point of common coupling for a grid-connected wind farm? What is the typical value voltage at the generator terminal?

xiv. What is the estimated range of percentage of time in a year for which a modern on-shore land-based wind farm generates electricity?

xv. Among the wind power producing countries in the world, which countries are ranked above India? Among the leading manufacturers of wind machines in the world, which Indian company is counted?

xvi. Which computational software tools are used in wind power industry for estimating annual energy production in a wind farm? Mention names of at least three software tools.

xvii. Explain: Solidity of rotor, Specific Rating of Wind Machine, Full load hours of a wind machine.

xviii. Draw a neatly labeled vector diagram of an airfoil section of a rotor blade rotating in a horizontal plane, showing different aerodynamic forces and resultant forces acing on the airfoil section of the rotating blade.

xix. What is the gear ratio required for gear-box to be used in a WPP having turbine RPM rating of 30 RPM and an electric generator RPM rating of 1500 RPM?

xx. Estimate percent increase of power produced by a given WPP with hub height of 50 m, capturing energy from incident wind at speed 6 m/s, when the hub height of the WPP is increased to 70 m at the same location? Assume the value of power law index to be 0.14.

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